KUMARAGURU
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Register Number:…….

M.TECH DEGREE EXAMINATIONS: APRIL / MAY 2023

(Regulation 2018)

Second Semester

DEFENCE TECHNOLOGY

P18DTT2009**:** Aerospace Propulsion

COURSE OUTCOMES

CO1: Knowledge about thermodynamics and fluid dynamics behind the aerospace system.

CO2: Understanding of Rocket motor design

CO3: Understanding of different design aspects related to propulsion systems used in aerospace.

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. Rearrange the following turbojet with afterburner engine components. CO1 [K_1]

   1. Combustor 2.Turbine 3.Afterburner 4. Intake 5.Compressor 6.Nozzle

   a) 2-3-4-1-5-6 b) 1-3-6-4-5-2

   c) 3-4-5-1-2-6 d) 4-5-1-2-3-6

2. The ratio of flight speed to the exhaust velocity for maximum propulsion efficiency is CO1 [K_2]

   a) 0 b) 0.5

   c) 1 d) 2

3. A turbo fan engine has a bypass ratio of 5 and a total mass flow rate is 120kg/s. The mass flow rate through bypass duct is CO1 [K_2]

   a) 20kg/s b) 100 kg/s

   c) 120 kg/s d) 150 kg/s

4. Matching type item with multiple choice code CO1 [K_2]

Engine	Operating Mach number
A. Turboprop	i)0.9
B. Turbofan	ii)4
C. Turbo jet	iii)2
D. Ram jet	iv)0.65

a) iv i ii iii b) iii iv ii i

c) iv i iii ii d) iii i ii iv

5. Which of the following is not a self-starting engine? CO2 [K_1]

a) Turbojet b) Ramjet

c) Turboprop d) Turbofan

6. After burner is a technique for CO2 [K_2]

a) Thrust augmentation b) Thrust reversal

c) Flame tube cooling d) Thrust vectoring

7. Assertion (A): Turboprop engines are limited to low speed and low altitude. CO2 [K_1]

Reason (R) : Due to the effect of propeller tip vortices and low pressure at high altitude, turboprop unable to operate.

a) Both A and R are Individually true, and R is the correct explanation of A b) Both A and R are Individually true but R is not the correct explanation of A

c) A is true but R is false d) A is false but R is true

8. The ratio of static enthalpy rises in rotor to the static enthalpy rise in stage is_____ CO3 [K_1]

a) Degree of reaction b) Blade coefficient

c) Degree of action d) Degree of freedom

9. An axial flow compressor that generates a stagantion pressure ratio of 4,operating with inlet and exit stagnation temperatures of 300K and 400K respectively .If the ratio of specific heats is 1.4,the isentropic efficiency of compressor is CO3 [K_2]

a) 0.94 b) 0.81

c) 0.72 d) 0.63

10. Air enters the combustor of gas turbine engine at total temperature of 500K and leaves the combustor at 1800K.If Cp remains constant at 1.005kJ/kgK and having calorific value of 44MJ/kg,The fuel air ratio is CO3 [K_2]

a) 0.003 b) 0.012

c) 0.031 d) 0.074

PART B (10 x 2 = 20 Marks)

11. Differentiate between closed and open system with examples . CO1 [K_2]
12. What is meant by quasistatic process ? CO1 [K_1]
13. Define compressible and incompressible flow. CO1 [K_2]
14. Differentiate between laminar and turbulent flow. CO1 [K_2]
15. Write down the thrust equation for jet engine . CO2 [K_2]

16.	Define propulsive efficiency.		CO2	[K_1]
17.	What is the need for cooling in gas turbine engine.		CO2	[K_2]
18.	Define stage in axial flow compressor .		CO3	[K_1]
19.	Define CFD and mention its applications .		CO3	[K_1]
20.	Differentiate between finite difference and finite volume method .		CO3	[K_2]

PART C (6 x 5 = 30 Marks)

21.	With the help of P-v and T-s diagram, derive the thermal efficiency of Brayton cycle .	5	CO1	[K_3]
22.	With the help of pressure time curve, briefly discuss about the different propellant grain configuration .	5	CO2	[K_2]
23.	With neat sketch, explain the working principle of standard strand burner for burning rate measurement.	5	CO2	[K_2]
24.	How to improve the cycle efficiency of Brayton cycle and briefly discuss about modified Brayton cycle .	5	CO2	[K_2]
25.	Draw the velocity triangle of axial flow compressor and explain the working principle for the same .	5	CO3	[K_3]
26.	Briefly discuss about the different steps in CFD Process.	5	CO3	[K_2]

Answer any FOUR Questions
PART D (4 x 10 = 40 Marks)

27.	Draw the P-v and T-s diagram for jet engine and perform the cycle analysis for the same.	10	CO2	[K_3]
28.	A turbojet engine aircraft flies with a velocity of 260 m/s at an altitude where the air is at 35kPa & -40^{O}C.The compressor has pressure ratio of 10 & the temperature of gases at turbine inlet is 1100^{O}C.Air enters at compressor at a rate of 45 kg/s .Utilizing the cold air standard assumptions .Determine 1.Temperature and pressure of gases at turbine exit .2.the velocity of the gases at the nozzle exit .3.The propulsive efficiency .	10	CO2	[K_3]

29.	Derive the thrust equation for turbojet engine .	10	CO1	[K_3]
30.	With neat sketch, explain the working principle of turboprop engine and mention its merits and demerits.	10	CO1	[K_3]
31.	In a Brayton cycle-based power plant the air at the inlet is $27^{O}C$,0.1MPa,the pressure ratio is 6.25 and the maximum temperature is $800^{O}C$ find the (a)compressor work (b)turbine work (c)heat supplied (d)thermal efficiency.	10	CO3	[K_3]

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